POTENTIAL URBAN IRRIGATION WATER SOURCES

An inventory of potential sources of irrigation water supply was conducted to address future irrigation water needs in the Study Area. These potential sources of supply were:

- Reclaimed wastewater from municipal wastewater treatment plants
- Water recovered during the dry season from reclaimed water aquifer storage and recovery (ASR) systems recharged during the wet season
- Surface water from streams, rivers, abandoned borrow pits, and canal systems having salinity control structures
- Water recovered during the dry season from surface water ASR systems recharged during the wet season
- Groundwater from irrigation supply wells

Reclaimed Water

Current and projected 2020 reclaimed water availability is presented in Tables 10 and 11. This source is equivalent to the projected wastewater flows. The values were generated by dividing monthly wastewater flows by service area populations. The resulting per capita wastewater generation factors were multiplied by the projected 2020 populations; allowing temporal variability to be accounted for in the future projections.

Reclaimed Water ASR Systems

Reclaimed water ASR is becoming more accepted with established regulations for obtaining the necessary permits throughout Florida. There are several reclaimed water ASR systems currently permitted and in some stage of startup and testing. Reclaimed water ASR is considered the best method for optimizing existing irrigation water supplies and balancing storage needs.

To determine the projected irrigation shortfalls that could be met by reclaimed water ASR systems, it was assumed the mean wet season wastewater flow for each utility would be injected for a period of 120 days and later recovered at an 75% efficiency rate for a period of 180 days. The 75% efficiency factor reflects the loss of some injected water through diffusion and dispersion with native groundwater in the storage aquifer. In this study it was assumed the UFA, which contains brackish native groundwater, would be used as the storage aquifer. The net result is the dry season recovery rate would be approximately 50% of the wet season mean injection rate in MGD, if recovery to a dissolved chloride concentration of 350 mg/l is permitted by SFWMD. The remaining dry season irrigation deficits would be met by supplemental sources of supply. Potential year 2020 mean dry season reclaimed water ASR recovery for the Study Area is 23 MGD, excluding contributions from the Marco Island WWTP, which are not anticipated to contribute to the system.

Table 10
Existing Monthly Average Wastewater Flows

Facility	Monthly Flows (MGD)												Annual Average (MGD)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Collier Co. North/ Pelican Bay	9.6	10	10.4	9.1	7.7	7.1	6.9	7.8	8.6	8.4	9.1	8.9	8.6
Collier Co. South	6.7	7	6.9	6.4	5.5	5.4	5.6	6.3	7.5	6.5	6.6	6.3	6.4
Golden Gate	0.9	0.8	0.8	0.8	0.8	0.8	1	0.9	1.5	0.9	0.8	0.9	0.9
Marco Island Utilities	2.5	3.1	3.4	2.7	3	3.1	2.9	3.2	1.9	2.1	2.1	2	2.7
Naples	6.7	6.9	7.3	6.8	5.6	5.8	7.8	7.1	6.8	6.7	6.8	6.7	6.8
Bonita Springs	2.9	3.2	3.1	2.9	2.3	2.1	2.5	2.4	3.1	2.4	2.3	2.4	2.6
Total Monthly Flow (MGD)	**29.3**	**31**	**31.9**	**28.7**	**24.9**	**24.3**	**26.7**	**27.7**	**29.4**	**27**	**27.7**	**27.2**	**28.0**

Table 11
Projected Year 2020 Monthly Average Wastewater Flows

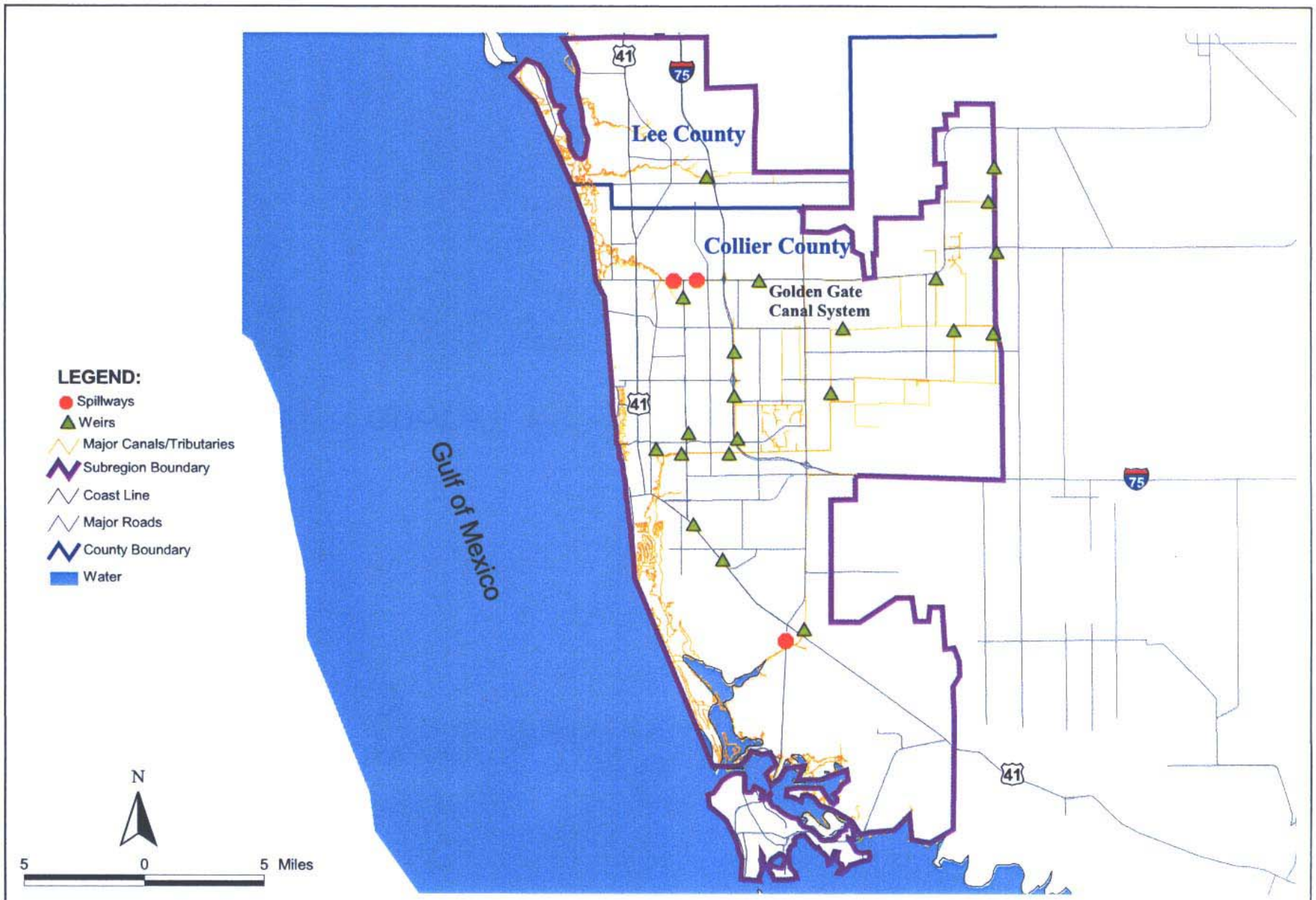
Facility	Monthly Flows (MGD)												Average (MGD)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Collier Co. North	20.2	21.1	21.9	19.2	16.2	15	14.7	16.5	18.2	17.8	19.1	18.9	18.2
Collier Co. South	14.2	14.7	14.7	13.5	11.5	11.4	11.9	13.2	15.9	13.7	13.9	13.2	13.5
Golden Gate	0.9	0.8	0.8	0.8	0.8	0.8	1	0.9	1.5	0.9	0.8	0.9	0.9
Marco Island Utilities	3.8	4.8	5.1	4	4.5	4.8	4.4	4.8	2.8	3.2	3.2	3.1	4.0
Naples	10.5	10.9	11.4	10.7	8.7	9.1	12.2	11.1	10.7	10.5	10.6	10.5	10.6
Bonita Springs	5.4	6	5.8	5.4	4.3	4	4.6	4.6	5.8	4.5	4.4	4.5	4.9
Total Monthly Flow (MGD)	**55**	**58.3**	**59.7**	**53.6**	**46**	**45.1**	**48.8**	**51.1**	**54.9**	**50.6**	**52**	**51.1**	**52.2**

Surface Water

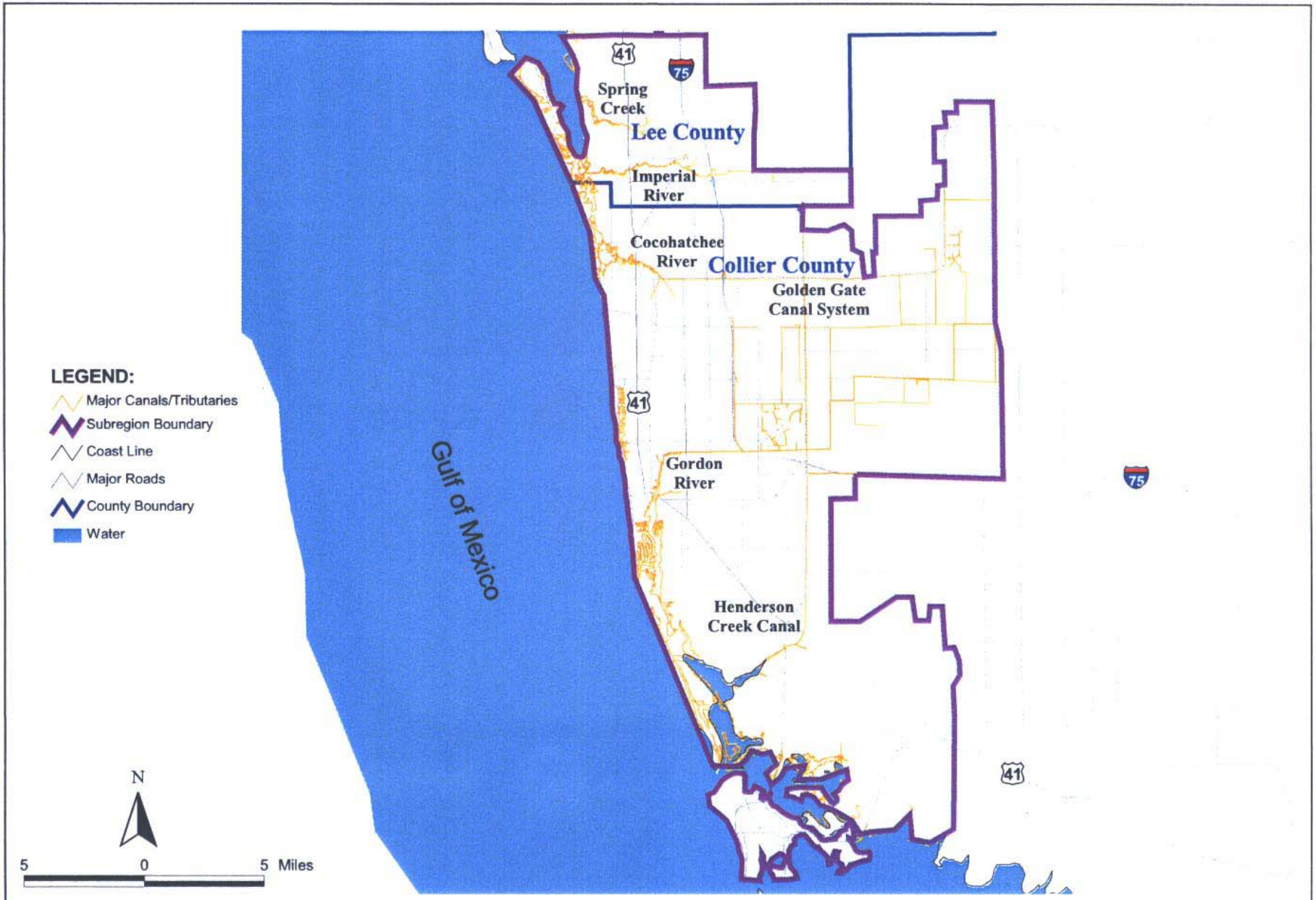
Figures 9 and 10 present the surface water bodies and major control structures within the study area. Flow for eight of the surface water bodies is measured and recorded by either the United States Geological Survey (USGS) or the District. Surface water stage data is available for one of the remaining two surface water bodies. Nine of the 10 surface water bodies inventoried have salinity control structures. This means these water bodies could be used as dry season sources of supply, if flow rates are deemed to be adequate. Available record flow data was tabulated and analyzed for the surface water bodies. Summaries of these tabulations and analyses are provided in Attachment C. An inventory of these streams, rivers, and canals in the sub-region is presented in Table 12.

In a typical year, the four-month period of highest surface water flow occurs from July through October. This represents an approximate one-month delay from the four-month period of highest rainfall (i.e., June through September). Therefore, in the analyses of the surface water flow data for this study, the wet season is considered to be July through October, and the dry season is considered to be the six-month period of December through May. The months of November and June are considered transitional and were not integrated into the statistical analyses.

To evaluate the potential use of surface water systems, a mean dry season flow of 20 MGD was set as a limiting factor. This would provide for 2 MGD if a 10% diversion rate for irrigation purposes were permitted. The remaining 90% of flow would support environmental needs. Based on these criteria, only two surface water bodies have potential for use as dry season sources of supply. These are the Golden Gate Canal system and the Faka Union Canal system. However, drought condition flow evaluations indicate the Golden Gate and Faka Union Canal systems would not be reliable sources during 1-in-10 year drought events. It should also be noted the Comprehensive Everglades Restoration Plan (CERP) will likely curtail future allocations from the Caloosahatchee River. The District has indicated that surface water should not be considered as potential dry season supplemental water source for the RIDS because of the CERP and ongoing shortages. Therefore, use of surface water as a supplemental irrigation source is limited to recovery from surface water ASR systems recharged during the wet season.



Regional Irrigation Distribution System (RIDS) Feasibility Study for the Lower West Coast Region	BOYLE	South Florida Water Management District	SURFACE WATER RESOURCES STRUCTURES SUBREGION 1	Figure 9



Regional Irrigation Distribution System (RIDS) Feasibility Study for the Lower West Coast Region	BOYLE	South Florida Water Management District	MAJOR WATER BODIES SUBREGION 1	Figure 10

Table 12
Summary of USGS and SFWMD Stream Flow Data

Water Body	Gauge Location	Period of Record	Mean Wet Season Flow (MGD)	Mean Dry Season Flow (MGD)	1-in-10 Year Dry Season Flow (MGD)	Utility Service Area
Golden Gate Canal System	17th Ave SW	1965-84	208	60	4	Collier County Utilities
Golden Gate Canal System	Airport Rd.	1964-84	394	82	2	Collier County Utilities
Faka Union Slough	0.5 miles north US 41	1978-99	342	64	0	Collier County Utilities
Cocohatchee River	Willoughby Acres Bridge	1969-99	45	7	1	Collier County Utilities
Imperial River*	Orr Road	1941-54, 1988-2000	146	17	7	Bonita Springs Utilities
Henderson Creek Canal	Near US 41	1968-99	29	5	0	Florida Water Ser./CCU
Spring Creek*	Old US 41	1989-2000	12	2	0	Bonita Springs Utilities
Gordon River	SR 886	1972-84, 1991-99	1	1	0	City of Naples
Okaloacoochee Slough	Near Sunniland	1979-80	N/A	N/A	N/A	Collier County Utilities
Kehl Canal	Near Bonita Garden Rd.	Unknown	Est. 117[1]	Est. 14[1]	0[2]	Bonita Springs Utilities

[1] Estimated as 80% of Downstream Flow at Orr Road on Imperial River
[2] From CH_2MHill, 2002 Report to Bonita Springs Utilities (rounded to nearest whole number)
*=No salinity control structure

Surface Water ASR Systems

Using the previously established criteria of a minimum wet season flow of 20 MGD and a diversion rate of 20% to a surface water ASR system, six potential surface water ASR systems were identified. These systems are presented in Table 13.

Table 13
Summary of Potential Surface Water ASR Systems

Irrigation Supply Source	*Pumping Station Location*	**Mean Dry Season Recovery Rate (MGD)[2]**	**Average Dry Season Surface Water Flow (MGD)[3]**	**Utility Service Area**
Golden Gate Canal System	17th Ave SW	21	15	Collier County Utilities
Golden Gate Canal System	Airport Rd.	39	18	Collier County Utilities
Faka Union Slough	0.5 miles north US 41	34	7	Collier County Utilities
Cocohatchee River	Willoughby Acres Bridge	5	1	Collier County Utilities
Imperial River*	Kehl Canal	12	1	Bonita Springs Utilities
Henderson Creek Canal	Near US 41	3[1]	2[1]	Florida Water Ser./CCU

[1] Source currently being used for municipal potable or reuse system.
[2] Based on 20% diversion of wet season surface water flow to ASR system for 120 days and 75% recovery efficiency for 180 days.
[3] Based on 10% diversion of dry season surface water flow.
* = No salinity control structure.

The storage aquifer for the potential surface water ASR systems was again (as in the case of reclaimed water ASR systems) assumed to be the UFA. A minimum distance of two miles from existing and permitted municipal RO supply wells and potable water ASR systems was used in the site selection process. In most cases the location selected for a surface water ASR system was adjacent to a control structure. For the Kehl Canal system, the ASR wellfield would be located 1 mile southwest of the Kehl Canal Weir at the Palmyra Country Club to maintain the desired 2-mile setback from the planned Bonita Springs East RO wellfield.

Groundwater

Groundwater is currently used as a supplemental irrigation source for reuse water by Collier County Utilities. Collier County Utilities uses Lower Tamiami Aquifer wells at its Pelican Bay wellfield and is utilizing water-table aquifer wells at Mule Pen Quarry to further supplement this system. The future use of water-table aquifer horizontal well systems located in road rights-of-way is potentially feasible. However, the use of vertical wells withdrawing from freshwater aquifers, constructed by municipalities, to provide supplemental water for irrigation purposes will likely be discouraged by the District. Because

the year 2020 supplemental irrigation water needs can likely be met within the study area by the alternative discussed herein, a more detailed evaluation of groundwater sources of supply is not provided as part of this study. However, as indicated above, the potential does exist for utilizing surficial aquifer horizontal wells as a supplemental RIDS source in selected locations. Also, horizontal wells constructed at select golf courses and other locations could be utilized as an injection water source for Floridan Aquifer ASR wells. This may serve to more efficiently utilize a resource that would otherwise be pumped from wet areas and stormwater systems and ultimately discharged to tidal water bodies during the wet season.

STORAGE AND DISTRIBUTION OPTIONS

Storage is the most critical part of the RIDS to optimize current sources and to balance supply and demand. ASR systems are considered an integral part of potential storage. A minimum distance of two miles from existing and permitted municipal RO supply wells and potable water ASR systems was used in the site selection process. Also, a semi-regional approach for reclaimed water ASR systems was utilized to maximize the recharge capacity of such systems while providing siting flexibility.

Aquifer Suitability for Surface and Reclaimed Water ASR

The data used in this investigation come from several sources including Water Resource Solutions (WRS) in-house database, SFWMD, Florida Geological Survey, Florida Department of Environmental Protection, Bureau of Geology, consultant reports, and publications.

Because of its extensive use in coastal areas of the region, the study did not consider the MHA system as a potential ASR storage interval, but rather was focused on the UFA, starting from the LHA down through the Ocala. Data from existing ASR systems, existing RO systems, and available wells which provide some information about the UFA were evaluated and used to delineate locations for potential surface water and reclaimed water ASR systems.

A total of 113 deep wells were inventoried in the area (Attachment D). Wells with either lithological or geophysical log information were reviewed to delineate the hydrostratigraphy of the area. A hydrostratigraphic database is provided (Attachment E). As shown, information for 84 wells, regarding shallow aquifers (from MHA to Water Table Aquifer) was obtained from the recently completed SFWMD "Lower West Coast Potentiometric Mapping Project" (WRS, 2003). Four cross-sections showing the hydrostratigraphy of the area were generated. A map showing lines of cross-section is provided and the cross-sections are provided as Attachment F. A subsurface structure contour map on top of Suwannee Formation is also provided. As seen on the cross-sections some zones of the LHA/UFA may potentially be suitable for ASR. Criteria for selecting potential ASR zones include confinement above and below, a thickness of between 40 and 100 feet, and a lack of nearby users of the zone. Site-specific subsurface testing will be needed to demonstrate the feasibility of the potential aquifer zones at each location.

Planned ASR Systems

The following ASR systems are either planned or have been identified as potential systems by municipalities in the Study Area. Some of these may be in concert with the RIDS, if they are constructed.

- Collier County North Reclamation Facility (Pelican Bay Wellfield)

- Kehl Canal Surface Water ASR System
- Pelican Landing Reclaimed Water ASR System
- Bonita Bay Reclaimed Water ASR System
- West Water Reclamation Facility

Potential Surface Water and Reclaimed Water ASR Systems

Based on the RIDS Master Plan evaluation of surface water flows and the present detailed subsurface evaluation, five potential surface water ASR systems have been identified. These are:

- Golden Gate Canal at 17th Ave.
- Golden Gate Canal at Airport Rd.
- Faka Union Slough
- Cocohatchee River
- Kehl Canal

It should be noted that Imperial River and Henderson Creek Canal potential surface water ASR systems have been removed from the original list proposed in the RIDS Master Plan. This is because the Henderson Creek Canal already has an ASR system while the Imperial River has no salinity control structure.

Integrating the hydrostratigraphic information with the capacities of the planned and existing infrastructure for the reclaimed water facilities in the sub-region, eight potential reclaimed water ASR systems were identified. These potential reclaimed water ASR systems are:

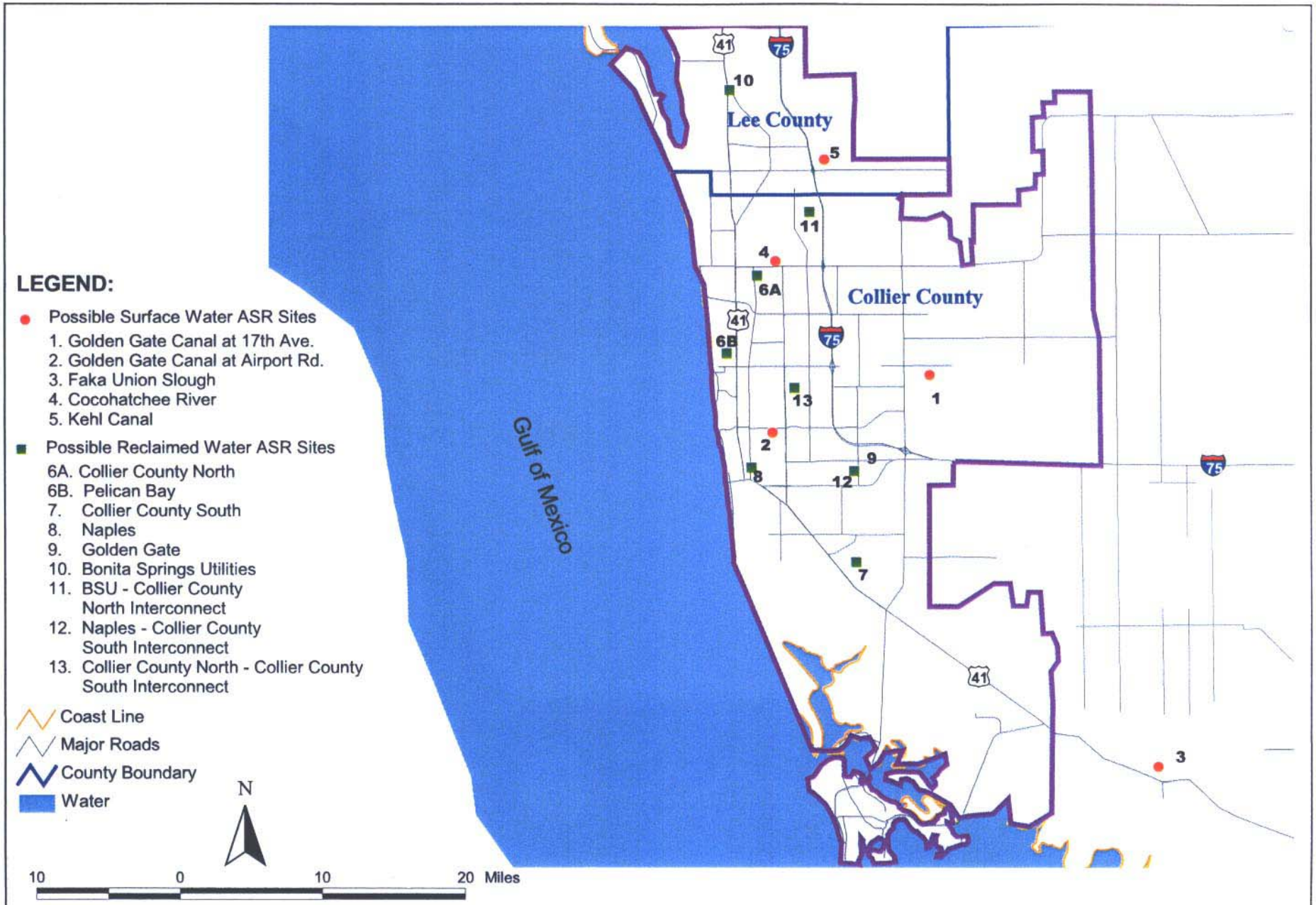
- Collier County North/Pelican Bay Area
- Collier County South Water Reclamation Facility
- Naples Wastewater Treatment Plant
- Golden Gate Wastewater Treatment Plant
- Bonita Springs Utilities West Water Reclamation facility
- BSU – Collier County North Interconnection
- Naples – Collier County South Interconnection
- Collier County North – Collier County South Interconnection

Details on these potential surface water and reclaimed water ASR systems are presented and ranked in Table 14. The rankings were based on the system's potential to significantly contribute to a RIDS. The ranking considered capacity, proximity to existing infrastructure, and potential for success as discussed herein. System locations are shown on Figure 11.

Table 14
Collier County – Bonita Springs Sub-Region
Summary of Ranked Potential Surface Water & Reclaimed Wastewater ASR Systems

ASR SITE #	DESCRIPTION	LOCATION (QTR S-T-R)	PTD (ft)	MEAN DRY SEASON RECOVERY RATE (MGD)	ULTIMATE # WELLS	POTENTIAL STORAGE ZONES	OVERALL RANK
Surface Water ASR Systems							
1	Golden Gate Canal at 17th Ave.	SW 14-49S-26E	950	20.0	28	SU I, II, III	2
2	Golden Gate Canal at Airport Rd.	NE 35-49S-25E	1000	25.0	35	LH I, II, III: SU I, II, III	1
3	Faka Union Slough	SE 04-52S-28E	950	25.0	35	LH I, II: SU I-IV	10
4	Cocohatchee River	SW 24-48S-25E	1100	5.0	8	LH I; SU I-V	11
5	Kehl Canal	SW 31-47S-26E	1200	12.0	18	SU II & III	9
Reclaimed Water ASR Systems							
6A	Pelican Bay	NW 26-48S-25E	1100	8.1	13	LH I & II; SU I-V	7
6B	Collier County North	NE 09-49S-25E	1100				
7	Collier County South	C 20-50S-26E	900	6.6	11	LH III; SU I-III	8
8	Naples	N/2 03-50S-25E	95	5.4	14	LH I-III; SU I-III	6
9	Golden Gate	N/2 33-49S-26E	95	0.5	2	LH I, II, IV; SU I-III	13
10	Bonita Springs Utilities	SE 16-47S-25E	1200	2.4	5	LH I & II; SU I-III	12
11	BSU - Coll. Cnty North Interconnect*	C 13-48S-25E	1100	10.5	15	LH I & II; SU I-V	5
12	Naples - Coll. Cnty South Interconnect*	C 05-50S-26E	1000	12.0	18	LH I-III; SU I-IV	3
13	Coll. Cnty North - Coll. Cnty South Interconnect*	C 13-49S-25E	1050	14.7	21	LH I-III; SU I-III	4

QTR S-T-R = Quarter Section-Township-Range
PTD = Proposed Total Depth
MGD = Million Gallons Per Day
LH = Lower Hawthorn portion of Upper Floridan Aquifer System
SU = Suwannee portion of Upper Floridan Aquifer System
I = Zone I
*ASR recovery rates for the interconnect options are redundant with the other reclaimed water ASR options, i.e., not all of the potential reclaimed water ASR systems need be constructed to maximize the resources.



Feasibility Study for the Regional Irrigation Distribution System (RIDS) for the Lower West Coast Region	BOYLE	South Florida Water Management District	POSSIBLE SURFACE AND RECLAIMED WATER ASR SITES SUBREGION I	Figure 11